The Effect of COVID-19 on Women's Employment: A Cross-Country Analysis

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Using occupation-specific data from the United States, as well as region- and state-specific data from both the United Kingdom and United States, I study the effect of COVID-19 on the unemployment gap of women minus men. An increase in the ability to work from home in the US after the start of the COVID-19 pandemic results in a .972 percentage point increase in the gender unemployment gap in a given occupation, relative to when COVID-19 is not present. In the UK, an increased ability to work from home in regions with stay-at-home orders in place is associated with a 1.813 percentage point decrease in the gender unemployment gap, relative to regions without lockdown measures, compared to a 9.309 reduction in the US.

I. Introduction

The COVID-19 pandemic has affected women's employment more than men's, as women tend to work in sectors that have been most affected by government measures to minimize the spread of COVID-19. The mechanisms behind this have not yet been explored, particularly at the regional level. This paper examines the effect that local lockdown measures and school closures have had on the unemployment gap of women minus men across the United Kingdom and the United States, while controlling for the ability to work from home in a given region. Further, this paper also explores the effect that the ability to work from home in a given occupation has on the gender unemployment gap in the United States. The aim of both analyses is to better understand the extent to which the COVID-19 pandemic has affected women's employment, both across industries and within countries.

As Alon et al. (2020a) notes, the current COVID-19 recession does not follow trends generally seen during economic contractions. Typically, as Doepke and Tertilt (2016) observe, economic recessions tend to affect men's employment more adversely than that of women. However, widespread stay-at-home orders, school closures, and social distancing measures, which were put into force to minimize the spread of COVID-19, have fundamentally altered the behaviors of both people and businesses during this pandemic recession.

In the United States, according to the Bureau of Labor Statistics, women's unemployment rose above men's, with rates of 16.1% and 13.6%, respectively, in April 2020. However, according to the Office for National Statistics, the same increases were not seen in the United Kingdom, where women's unemployment in the second quarter was 3.9%, compared to a rate of 4.2% for men. By exploring the effect of regional differences during the pandemic on the gender unemployment gap, this paper aims to better understand the role of COVID-19 related policies

within countries on the gender unemployment gap in the United Kingdom and United States.

Alon et al. (2020a) asserts that the large employment losses seen by women in the COVID-19 recession, in contrast to previous recessions, is largely due to the prevalence of women in sectors most effected by COVID-19 restrictions, such as restaurants, and increased childcare needs due to widespread school and daycare closures. Further, Sevilla and Smith (2020) find that within couples, COVID-19 has increased the equality in time spent on childcare between men and women. However, they also observe that the change in the quantity of childcare supplied by men was largely dependent on their employment status, while that of women increased irrespective of theirs. This analysis adds to the existing literature by examining the role that occupation and regional differences have had on the gender unemployment gap during the COVID-19 pandemic in both the United Kingdom and the United States.

To understand the effect of the COVID-19 pandemic on gender differences within occupations in the United States, I use an OLS model with both time and occupation fixed effects. I find that, on average, an increase in the ability to work from home when COVID-19 is present results in a 0.972 percentage point increase in the gender unemployment gap relative to when COVID-19 is not present, holding all else equal. This is statistically significant at the 5% level.

Next, to understand the cross-country differences in the effect of the COVID-19 pandemic on the gender gap in unemployment in the United Kingdom and United States, I employ an OLS model with fixed effects on both time and region. For the United Kingdom, I find that an increase in the ability to work from home in regions with stay-at-home orders in effect results in a 1.813 percentage point decrease in the gender unemployment gap, relative to regions without lockdown measures, holding all else equal. In the United States, I find that an increase in the ability to work from home in states with statewide stay-at-home orders in effect results in a

9.309 percentage point reduction in the unemployment differential between women and men, relative to states without stay-at-home measures, holding all else equal. These results are consistent with the findings of Adams-Prassl et al. (2020) and Bartik et al. (2020), who find that the ability to work from home is an important determinant of employment status during the COVID-19 pandemic. This is especially true for employed persons with children, following the observations of Albanesi and Kim (2020) and Alon et al. (2020b).

This paper is proceeds as follows. Section 2 outlines the current literature on women's employment and the effect of COVID-19 on gender differences in employment. Section 3 gives an overview of the data used in the empirical model, while section 4 describes the models used. Section 5 provides and interprets the results, and section 6 discusses their implications.

II. Literature Review

Understanding the gender gaps in unemployment during the current pandemic recession is important due to the unique features of this recession. Historically, economic contractions have been observed to affect different facets of the economy in similar ways. Typical recessions see declining gross domestic product coupled with rising unemployment rates. Further, men's employment also tends to be more adversely affected than that of women. Doepke and Tertilt (2016) find that women's aggregate labor supply tends to be less volatile compared to men, with evidence from 1962 to 2014. They also find that married women experience the lowest volatility in employment, particularly in the Great Recession of 2008. Additionally, Albanesi (2019) observes that the number of hours women work in a given year display substantially lower cyclicality than male hours, and that gender specific shocks account for a large fraction of variance of output, hours, and investment over medium and long horizons.

There are various explanations in the existing literature as to why there is a difference in the volatility of employment by gender. One theory, as postulated by Doepke and Tertilt (2016), is that women's employment serves as employment insurance within the family. So, married women increase their labor supply when their husbands' decreases, resulting in a lower volatility of their overall employment. Alternatively, Coskun and Dolgaic (2020) suggest that the gender differential in employment volatility is due to the sectoral composition of female and male employment. Women are more likely to be employed in counter-cyclical industries, like "Education and Health Services," whereas men tend to be employed in cyclical sectors, such as "Manufacturing" and "Construction." Therefore, men see higher rates of unemployment in typical economic contractions, because their employment tends to be highly correlated with business cycles. However, it is important to note that these explanations are not mutually exclusive, nor independent, as married women could choose to work in a counter-cyclical sector, because their partner is employed in a cyclical one. Moreover, as Coskun and Dolgaic (2020) note, the alternative could also hold true in some couples.

In contrast to previous recessions, the COVID-19 recession does not follow these patterns. I build on the literature that studies the disproportionate effect of the COVID-19 pandemic on women's employment by examining the role that regional differences, such as local lockdown measures, have had on the gender unemployment gap in the United Kingdom as well as the United States. Alon et al. (2020b) argues that increased unemployment gap between women and men seen during the pandemic is primarily because women's employment is highly concentrated in sectors heavily affected by government measures to contain the spread of COVID-19. Therefore, the closure of non-essential businesses, like restaurants, as well as daycare and school closures have inordinately affected women's ability to work. However, similarly to Del Boca et al. (2020) and Sevilla and Smith (2020), Alon et al. (2020b) observes that while women are still

disproportionately responsible for childcare and housework, the pandemic seems to have contributed to decreasing this inequality within couples. It is also important to note that the increase in the quantity of childcare supplied by men is much more sensitive to their employment status than that of their female partners, according to Sevilla and Smith (2020).

I also explore how decreases in women's mobility, due to regional stay-at-home orders and school closures, have affected the unemployment gap between women and men. Caselli et al. (2020) observes a dramatic decrease in women's mobility, or the proportion of women in each province that leave their home in a given day, at the start of the pandemic in Italy, Spain and Portugal. Following the assertion of Alon et al. (2020a) that women are more likely to care for children when schools are closed, Caselli et al. (2020) finds that lockdown measures, particularly school closures, reduce the mobility of women considerably more than men. In Italy, they observe that a national school closure, which occurred one week prior to a national lockdown, significantly decreased women's mobility, while men's mobility decreased only marginally. This analysis, coupled with the observations of Alon et al. (2020a), helps explain why women's employment has been particularly affected during the pandemic recession, as childcare constraints due to school closures likely prevented women from working in jobs unable to be done from home in areas where stay-at-home measures were not present.

I employ the findings of Dingel and Neiman (2020), who estimate the share of jobs that can be done from home both by occupation and state, to control for regional differences in the ability to work from home, in order to better understand the gender unemployment gap in the United States. Dingel and Neiman (2020) also approximate the share of jobs that can be done remotely by country, and they find that this share is positively correlated with income. Similarly, they find that the share of jobs that can be done from home in a given industry is highly positively correlated with education. Bartik et al. (2020) also notes that there is a positive

correlation between the probability of switching to remote work at the start of the pandemic and the historical share of industry employees able to work from home. They conclude that the Dingel and Neiman (2020) classification of ability to work remotely is a salient determinant of actual remote work. Further, Adams-Prassl et al. (2020) observes a monotonic relationship between the share of tasks that can be done from home and job loss. They also find a gender gap in the ability to work from home in the United States and United Kingdom, as men tend to have a greater ability to work remotely than women.

This paper expands on the analysis of Adams-Prassl et al. (2020) by investigating how cross-country differences in labor market policies have affected the unemployment differential between women and men across the United Kingdom and United States. Further, I examine the extent to which regional differences within countries have contributed to the disproportionate rise in women's unemployment, relative to men, particularly in the United States. Using data from real time surveys, Adams-Prassl et al. (2020) finds that within countries the pandemic has largely exacerbated existing inequalities. Their paper, however, focuses largely on the magnitude of the COVID-19 shock within specific companies in each country, primarily using changes in hours worked of those surveyed.

III. Data

This section describes first the policy responses each country implemented after the start of the COVID-19 pandemic and then the data to be used in the empirical model.

A. Cross-Country Policy Responses to COVID-19

United Kingdom.— The first known COVID-19 death occurred on January 30, 2019, and on March 18, most schools in England, Wales and Scotland were ordered closed (Aspinall 2020). By the end of the month, with cases continuing to rise, Boris Johnson announced a nationwide lockdown, ordering all citizens to remain in their homes. Further, the United Kingdom announced measures to keep workers paid and employed under the Coronavirus Act, called the *Coronavirus Job Retention Scheme*. This policy allows the government to pay grants to employers for employees who are kept on payroll but not working, covering 80% of wages and employment costs of up to £2,500 per person per month. This originally meant that furloughed workers could not work any additional hours, but it has since been amended to also include replacement of partial wages lost. Additionally, it paid a grant of 80% of self-employed profits, up to £2,500 per month, to support self-employed individuals who earned less than £50,000 in the previous fiscal year (Coronavirus Act 2020). The first lockdown was lifted in the United Kingdom on May 10, with a phased reopening of schools and businesses.

United States.— The United States declared the COVID-19 pandemic a national emergency on March 25. The CARES Act was passed shortly thereafter, where individuals earning less than $75,000 received one-time cash payments of $1,200, and married couples earning less than $150,000 received payments of $2,400 and an additional $500 per dependent child under 18. Unemployment insurance was extended by 13 weeks, and claimants received an additional $600 per week, and it was expanded to include freelancers, furloughed employees and gig economy workers (CARES Act 2020). There was also a small business emergency loan fund, and cash available for larger businesses. By March 27 most schools across the country closed, opting for remote instruction, and many states issued "stay-at-

home" orders. More stimulus measures have since been passed, but not before December 2020, which is outside the scope of this analysis.

B. Data Collection

United Kingdom.—This paper uses panel data on the quarterly unemployment rates by gender and region, from January 2018 to September 2020, from the Annual Population Survey published by the Office for National Statistics. The data is not seasonally adjusted. This time period was chosen in part due to data availability, as well as a desire to have a sufficiently large pre-COVID-19 period. Using two full quarters after the initial COVID-19 shock also allows for a better understanding of the effect that COVID-19 policies have had on the labor market within the United Kingdom. Figure 1 shows the average quarterly unemployment levels for men and women, respectively. The mean unemployment rate for women is 3.9%, compared to 4.2% for men, with a standard deviation of 0.2% and 0.1%, respectively. Interestingly, women's unemployment seems to have decreased during the pandemic, whereas men's unemployment was constant and began to rise in the second quarter of 2020. Additional summary statistics can be found in Table 1 of the Appendix.

To obtain the gender unemployment gap used in the empirical analysis, the men's unemployment rate is subtracted from the women's unemployment rate for each quarter, for all 12 regions. The mean regional gender unemployment gap is -0.4%, with a standard deviation of 0.7%. Detailed summary statistics on the gender unemployment gap can be found in Table 2 of the Appendix.

Data on the ability to work from home in a given region of the United Kingdom is available from the Office of National Statistics' Labor Market Survey in April 2020. This measures the proportion of people in a given region who did any remote work during the week they were surveyed. Figure 2 shows the share of people able

to work from home by region. It is worth noting that workers in London had the highest share of people who were able to work from home, 57.2%, while the smallest share was found in the West Midlands, with 35.5% of people working remotely in April 2020. Since data on the ability to work from home was only measured in April 2020, it is assumed to remain constant in this analysis. For this analysis, the share of people able to work remotely in a given region is recorded as a decimal, rather than a percent. More detailed summary statistics on this data can be found in Table 2 in the Appendix, but the average proportion of people working from home across the United Kingdom is 0.5, with a standard deviation of 0.3.

Data on region-specific lockdowns is taken from GOV.UK, which has a comprehensive outline of lockdown measures taken and their duration. For this analysis, a region was considered under a stay-at-home measure and assigned a value of 1 if there was a mandatory lockdown in effect during a given quarter. If there were no lockdown measures in effect in that quarter, that region was assigned 0. This was repeated for all regions for each quarter in this analysis. It is important to note that the United Kingdom's lockdown measures were implemented nationally from March 23 to May 10, after which point it began to gradually ease restrictions. More localized measures, through the use of a tier system, were not implemented until October, which is outside the scope of this analysis. Leicester, located in the East Midlands region, is an exception to this and had a local lockdown beginning July 4. The mean lockdown value is 0.1, with a standard deviation of 0.3; see Table 2 in the Appendix for more detailed summary statistics.

United States.—I use monthly unemployment data by gender, state and occupation from January 2019 to May 2020. Since this data is available monthly, it is not necessary to have as extensive of a pre-COVID-19 period as the one used in the United Kingdom. Further, restricting the scope of this analysis to May 2020 allows for a better understanding of the initial COVID-19 shock on the labor markets.

Figure 3 shows the average monthly unemployment rate levels by gender across the United States. The average unemployment rate for women is 5.0%, while that of men is 4.9%, with a standard deviation of 3.9% and 3.0%, respectively. For additional summary statistics, see Table 3 in the Appendix.

Data on women and men's monthly unemployment rates by occupation were obtained from the Bureau of Labor Statistics Data Finder, using information from the Labor Force Statistics Current Population Monthly Survey and are not seasonally adjusted. The unemployment rate of women in a given occupation was then subtracted from that of men for each month. It is worth noting that almost all occupations saw a rise in unemployment after the COVID-19 shock, even those designated as "essential" occupations, like "Healthcare Practitioners and Technical Operations." This is likely because there are a multitude of jobs within an occupation, each effected by COVID-19 differently. The average unemployment differential across occupations is 0.9%, with a standard deviation of 3.2%. See Table 4 in the Appendix for additional summary statistics.

State-specific data on the unemployment rate by gender is also taken from the Bureau of Labor Statistics, using data from the Labor Force Statistics Current Population Monthly Survey. This data is only available in counts, so for each month I sum the total number of unemployed women and divide that by the total number of women in the labor force. This is then multiplied by 100. I repeat this process to find the monthly unemployment rate in each state for men. Then, I subtracted the unemployment rate of men from that of women in order to arrive at the gender unemployment gap used in this analysis. This process is repeated for all 50 states and the District of Columbia. The data is not seasonally adjusted. The average state unemployment gap is -0.03%, with a standard deviation of 1.9%. For more summary statistics, see Table 5 in the Appendix.

The share of people working from home in each state is not yet supplied by the Bureau of Labor Statistics, so the share of jobs that can be done remotely in a given

state, and occupation, is taken from the analysis of Dingel and Neiman (2020). They use pre-COVID-19 Occupational Informational Network (O*NET) survey data to capture sectors that are able to be done remotely and those that are not. They then weight this information by wages and report the share of jobs they estimate can be performed at home by occupation and by state. Figure 4 shows the ability to work from home by state throughout the United States. The average share of jobs that can be performed remotely across occupations is 0.3, with a standard deviation of 0.3. The average share of jobs that can be done remotely by state is also 0.3, with a standard deviation of 0.05. The summary statistics of each can be found in Tables 4 and 5 of the Appendix, respectively.

Data on state-specific stay-at-home orders is taken from the CDC. For this analysis, a state was considered under a lockdown order if there was a statewide mandatory stay-at-home order in a given month. If there was an order, that state was then assigned a value of 1. If there was not a mandatory stay-at-home order in effect, that state was assigned a value of 0. The mean value of stay-at-home orders is 0.1, with a standard deviation of 0.3, and more summary statistics can be found in Table 5 in the Appendix. The median start date of all stay-at-home orders in the United States is March 27, though some states never implemented stay-at-home restrictions. South Carolina was the latest state to implement a lockdown order on April 7, and California was the first to implement one on March 19. States that never implemented a stay-at-home order are Arkansas, Iowa, Nebraska, North Dakota, South Dakota, Utah and Wyoming.

Data on statewide school closures by month are taken from *Education Week*, an independent news organization on K-12 education. This data is not yet available for the United Kingdom. For this analysis, a school was considered closed and assigned a value of 1 if there was a statewide closure of schools in a given month. Otherwise, it was assigned 0. This was repeated for all months included in this analysis, across all states and the District of Columbia. The mean value of state

school closures is 0.2, with a standard deviation of 0.4. Additional summary statistics can be found in Table 5 of the Appendix.

IV. Empirical Approach

The first section will explain the occupation-specific model used to investigate the effect of the ability to work from home on the unemployment differential in a given occupation. Data on unemployment rates by gender and occupation are not yet available for the United Kingdom, so this model will focus on the United States. The following section will explain the region-specific model that investigates the effect of regional lockdown measures on the gender unemployment gap within the United Kingdom and the United States.

A. Occupation-Specific Model

This section uses an OLS model with a fixed effects approach to investigate how the ability to work from home in a given occupation has affected the unemployment differential between women and men throughout the pandemic in the United States.

$$(1) \qquad Y_{i,t} = \beta_0 + \beta_1 WFH_i + \beta_2 COVID_{\mathrm{t}} + \beta_3 WFH_i * COVID_{\mathrm{t}} + \gamma_1 occupation_1 + \cdots + \gamma_{n-1} occupation_{n-1} + \delta_1 time_1 + \cdots + \delta_{t-1} time_{t-1} + u_{i,t}$$

$Y_{i,t}$ indicates the gender unemployment rate differential *(women-men)* in a given occupation, *i*, at a given time *t*. WFH_i is the share of jobs in a given occupation that are able to be done from home, as estimated by Dingel and Neiman (2020), and $COVID_{\mathrm{t}}$ is a dummy variable which equals 0 in all months prior to the start of the pandemic, and 1 for all months following March 2020. I then use fixed effects across occupations and time for *(n-1)* occupations and *(t-1)* months included in this analysis.

The coefficient β_1 measures the average change in the gender unemployment gap when there is a one unit increase in the ability to work from home, holding all else equal. β_2 measures the effect of the presence of COVID-19 on the mean change in the gender unemployment gap, relative to when it was not present, holding all else equal. β_3 measures the additional effect of an increase in the ability to work from home on the gender unemployment differential when COVID-19 is present, relative to when it is not, holding all else equal.

B. Region-Specific Model

This section also uses an OLS model with fixed effects to better understand the effect that regional differences have had within countries over the course of the pandemic. This allows for a more thorough analysis of the gender unemployment differential within both the United Kingdom and the United States.

$$(2) \qquad ue_{diff_{i,t}} = \beta_0 + \beta_1 WFH_i + \beta_2 lockdown_t + \beta_3 (WFH_i * lockdown_{i,t}) + \gamma_1 region_1 + \cdots + \gamma_{n-1} region_{n-1} + \delta_1 time_1 + \cdots + \delta_{t-1} time_{t-1} + u_{i,t}$$

$ue_{diff_{i,t}}$ indicates the unemployment rate differential *(women-men)* in a given region or state, *i,* at a given time *t,* WFH_i is the share of jobs that can be done from home in a given region *i,* and $lockdown_{i,t}$ is a dummy variable equal to 1 when a given state or region *i* has a mandatory stay-at-home order in place at time *t,*and 0 otherwise. For region fixed effects, $region_1$ represents a dummy variable for each region in the United Kingdom, and each state, including the District of Columbia, in the United States, for *(n-1)* regions and states. The time fixed effects, $time_1$ indicates the start of the panel data, which occurs on Q1 of 2018 for the United Kingdom and January 2019 for the United States. This continues for *(t-1)*

time observations, which are quarterly for the United Kingdom data and monthly for the United States.

The coefficient β_1 measures the effect of a one unit increase in the ability to work from home on the average change in the unemployment differential, all else equal. β_2 measures the average change in the gender unemployment gap for regions with stay-at-home orders in place, relative to regions without lockdown orders in place, holding all else equal. Lastly, β_3 measures the additional effect of the ability to work remotely in regions with stay-at-home measures in place, relative to those without, on the gender unemployment gap, all else equal.

Additionally, to examine the role of school closures on the gender unemployment gap in the United States, $lockdown_{i,t}$ is replaced by $school\_closure_{i,t}$. This variable is equal to 1 if a given state *i* ordered all K-12 schools to be closed in month *t* after the start of the pandemic. If there was no statewide mandate, or school closures varied by district, the variable is equal to 0. The interpretation of all of the coefficients remains the same as above, except β_3 now measures the additional effect of the ability to work remotely in states with school closures, relative to those without, on the gender unemployment gap, holding all else equal.

V. Results

A. Occupation-Specific Model

As seen in Table 6 in the Appendix, the ability to work remotely has a statistically significant effect on the gender unemployment gap, at the 5% level. For a one unit increase in the ability to work remotely, there is a 2.292 percentage point increase in the gender unemployment gap between women and men, on average, holding all else equal. When fixed effects are removed from the model, however, this effect becomes negative but remains statistically significant at the 5% level.

Holding all else equal, the presence of COVID-19 is associated with a mean increase of 3.618 percentage points in the gender unemployment gap, relative to when COVID-19 is not present. This result is statistically significant at the 1% level. It also holds when fixed effects are removed from the model, though slightly decreases in magnitude.

The interaction effect between the share of jobs that can be done remotely within an occupation and the presence of COVID-19 is negative and statistically significant at the 5% level. When COVID-19 is present, an additional increase in the share of tasks able to be performed from home is associated with, on average, a 0.972 percentage point increase in the gender unemployment gap, relative to when COVID-19 is not present, holding all else equal. This effect becomes negative, but loses some of its statistical significance, when fixed effects are removed from the model.

B. Region-Specific Model

United Kingdom.— Table 7 shows the effect that regional lockdown measures have on the gender unemployment gap. On average, regions with stay-at-home orders in place see a 0.613 percentage point decrease in the gender unemployment differential of women minus men, relative to regions without local lockdown restrictions in place, holding all else equal. This result, however, is not statistically significant. Further, when fixed effects are removed from the analysis, this effect becomes slightly positive.

A one unit increase in the share of people able to work from home in a given region results in a .914 percentage point increase in the gender unemployment differential, on average, holding all else constant. This means that a higher ability to work from home, not considering COVID-19, is associated with an increase in the unemployment differential between women and men. This result is not

statistically significant, however. Additionally, when fixed effects are removed from the model, the coefficient becomes negative.

The interaction effect between the ability to work from home and the presence of stay-at-home orders in a given region is negative, though statistically insignificant. On average, there is a 1.813 percentage point decrease in the gender unemployment gap, associated with an increase in the ability to work remotely, in regions with local lockdown measures in place, relative to those without, holding all else equal. This result remains negative when fixed effects are removed from the model.

United States.— As seen in Table 8, statewide stay-at-home measures have a positive effect on the gender unemployment gap and are statistically significant at the 1% level. On average, states with mandatory stay-at-home orders in place are associated with a 4.226 percentage point increase in the gender unemployment gap, relative to states without stay-at-home orders, holding all else equal. This effect remains positive and statistically significant, though decreases in magnitude, when fixed effects are removed from the model.

The effect of the ability to work from home on the gender unemployment differential is also positive and statistically significant at the 1% level. For a one unit increase in the share of jobs that can be done from home, there is on average a 70.989 percentage point increase in the unemployment gap between women and men, holding all else equal. This result remains positive when fixed effects are removed, but it greatly reduces in magnitude and is no longer statistically significant.

The interaction between the ability to work from home and the presence of statewide stay-at-home orders is negative and statistically significant at the 1% level. On average, in states with mandatory stay-at-home orders in effect, the gender unemployment gap between women and men decreases by 9.309 percentage points, relative to states without stay-at-home orders, holding all else equal. This

effect remains negative but loses its statistical significance when fixed effects are removed from the analysis.

The effect of school closures on the gender unemployment gap is positive, though not statistically significant. The presence of a statewide school closure is associated with, on average, a .066 percentage point increase in the gender unemployment gap relative to states without school closures, holding all else equal. This effect becomes slightly more positive when fixed effects are removed from the model.

The interaction between the ability to work remotely and school closures on the gender unemployment gap is negative, but not statistically significant. On average, there is a 1.951 percentage point decrease in the gender unemployment differential for a one unit increase in the ability to work remotely in states with statewide school closures, relative to those without, holding all else equal. This effect becomes positive, however, when fixed effects are removed from the analysis.

VI. Discussion

A. Occupation-Specific Model

The effect of an increased ability to work remotely on the gender unemployment gap is positive. This seems counterintuitive, but it is consistent with the Adams-Prassl et al. (2020), who finds that there is a notable gender gap in the ability to work from home in the United States. Alon et al. (2020b) has a similar observation, finding that women are disproportionately employed in occupations that are not able to be done remotely, such has "Healthcare Services." Therefore, the gender composition of sectors leads to an understatement of the effect of the ability to work from home on the gender unemployment gap.

The presence of COVID-19 is associated with an increase in the gender unemployment gap, relative to when COVID-19 was not present. This is also consistent with the literature, as Alon et al. (2020a) finds that women are

disproportionately employed in sectors that have been inordinately affected by government efforts to thwart COVID-19. Therefore, women's employment has been greatly affected by the pandemic.

The effect of the interaction between the share of tasks able to be done remotely in a given industry and the presence of COVID-19 is both positive and statistically significant. Therefore, the unemployment gap between women and men increases in occupations with a higher ability to work remotely when COVID-19 is present, relative to when it is not. This is likely due to the gender composition of occupations, as noted in Alon et al. (2020b).

This analysis has some limitations. Specifically, it assumes that the Dingel and Neiman (2020) estimate of the share of jobs that can be done from home in a given occupation remains constant over time. This is a fairly significant assumption, as many jobs that allowed very limited or no ability to work remotely prior to the COVID-19 crisis, such as jobs on Wall Street, have gone completely remote during the pandemic. Alternatively, some industries which were originally considered "nonessential," were given exemptions and allowed to resume in person work a couple of months into the pandemic. Additionally, there is currently only data available on unemployment by gender for 18 occupation categories. These categories, such as "Ats, Design, Entertainment, Sports and Media," contain a multitude of jobs, each with their own education requirements. This is important, as Bartik et al. (2020) notes, the ability to work from home within an industry is highly correlated with the level of education required in that industry.

The effect of COVID-19 and the ability to work remotely on the gender gap in unemployment in given occupations, however, still has relevant policy implications. It shows the importance of the ability to work from home during the COVID-19 recession on the gender unemployment gap. Future policies should target helping those who are employed in occupations that cannot be done remotely, to avoid an adverse effect on women's employment in those industries.

B. Region-Specific Model

In both the United Kingdom and United States, there is, on average, a narrowing of the gender unemployment gap associated with an increased ability to work from home in regions with stay-at-home orders in place, compared to those without. In regions without lockdown orders in place, this gap widens, on average. Though these effects are only statistically significant in the United States, they demonstrate how COVID-19 has affected women's employment in both the United Kingdom and United States.

There are some limitations to this analysis. Firstly, in both countries, the share of jobs that can be done remotely is assumed to be constant over time. In the United Kingdom, this is measured by the share of people in a given region who did any work from home in April 2020. In the United States, this is taken from the analysis of Dingel and Neiman (2020) on the share of jobs able to be done from home in a given state. I assume that these rates are constant over time. This may not hold in reality, as many organizations started working remotely at the start of the pandemic, but as definitions of "essential" work changed, more employers opted for in person work. Additionally, within each region and state, there is a significant amount of heterogeneity in the ability to work from home. For example, more urban areas are likely to have a higher share of jobs able to be done from home than rural areas, but both are included in a given state, as noted by Dingel and Neiman (2020).

Another limitation to this paper is how states and regions are determined to have stay-at-home orders. A region is considered under a lockdown measure only if there was a mandatory order in place for the entirety of that region. This is not a perfect assumption, particularly for the United States, as many urban areas implemented strict lockdowns, even if the state as a whole did not issue mandatory stay-at-home restrictions; New York is an example of this.

A similar approach was used for school closures in the United States. School closures varied widely by district in many states, but this paper only considered school closed if there was a statewide mandate. However, most of the variation in school closures did not occur until the start of the 2020-2021 school year, which is out of the scope of this analysis.

Despite the limitations of this analysis, there are still meaningful implications from the results of both countries. In both the United Kingdom and United States, the ability to work from home in regions where stay-at-home orders are present is an important determinant in the degree to which the unemployment gap narrows. Further, as seen in the United States, there is a narrowing of the gender unemployment gap in states with school closures associated with an increase in the ability to work from home, relative to those without school closures. These effects are likely due to flexibility in childcare, as Dingel et al. (2020) notes that 32% of households in the United States have at least one child under 14 and must consider childcare when returning to in-person work. Additionally, as Del Boca et al. (2020) points out, women have borne the brunt of increased time needed for household and childcare work, regardless of their partner's employment status. Therefore, the ability to work from home allows for more flexibility within households during the COVID-19 pandemic and a lower unemployment differential between women and men. The importance of the ability to work from remotely, particularly in regions with lockdown measures, should be taken into consideration when making policy about how to best mitigate the disproportionate effects of the COVID-19 pandemic on certain demographics of workers, especially women.

VII. Conclusion

In both the United Kingdom and United States, it is clear that increases in the ability to work remotely in regions where COVID-19 stay-at-home orders are

present helps to narrow the gender unemployment gap between women and men, relative to regions without stay-at-home orders. Though the measures of the ability to work from home are not perfect, it is clear that policies seeking to aid those most effected by the COVID-19 crisis should take employed persons' ability to work remotely into consideration.

When data on occupation- and region- specific gender unemployment rates become available, it would be interesting to see the effects that regional differences within occupations, in addition to policy measures throughout the COVID-19 pandemic, have had on the gender unemployment gap.

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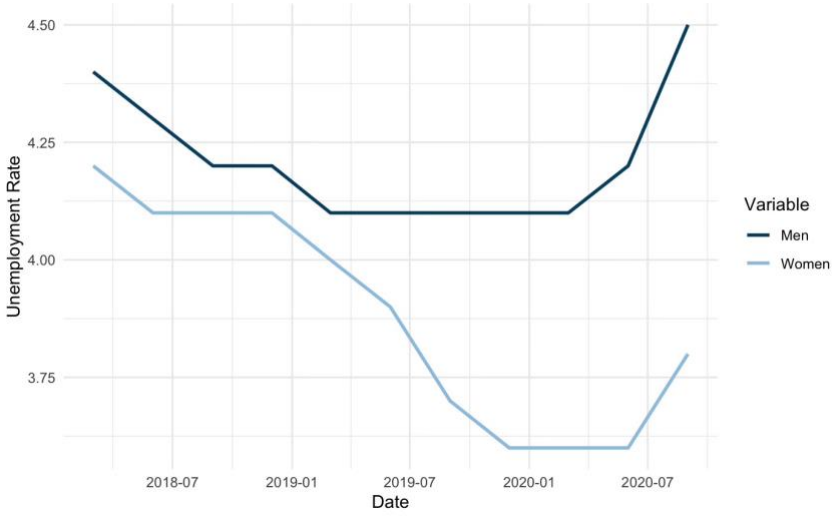
VIV. Appendix

FIGURE 1: UK UNEMPLOYMENT RATE BY GENDER



Notes: Quarterly unemployment rates used; data is not seasonally adjusted. Back to text
Source: Annual Population Survey published by the Office for National Statistics.

TABLE 1— UK QUARTERLY UNEMPLOYMENT LEVEL SUMMARY STATISTICS

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Women	11	3.9	0.2	3.6	3.7	4.1	4.2
Men	11	4.2	0.1	4.1	4.1	4.2	4.5
Differential (women-men)	11	-0.3	0.2	-0.7	-0.5	-0.2	-0.1

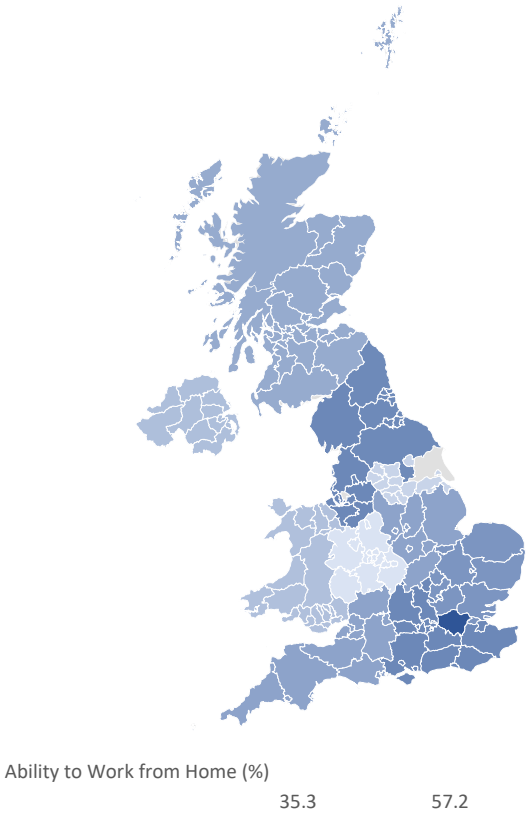
Notes: Data is available quarterly; data is not seasonally adjusted. Back to text
Source: Annual Population Survey published by the Office for National Statistics.

TABLE 2 – UK REGIONAL COVARIATE SUMMARY STATISTICS

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Regional UE Differential	132	-0.4	0.7	-3.0	-0.8	0.1	1.1
Lockdown	132	0.1	0.3	0	0	0	1
Share of People Working from Home	132	0.5	0.1	0.4	0.4	0.5	0.6

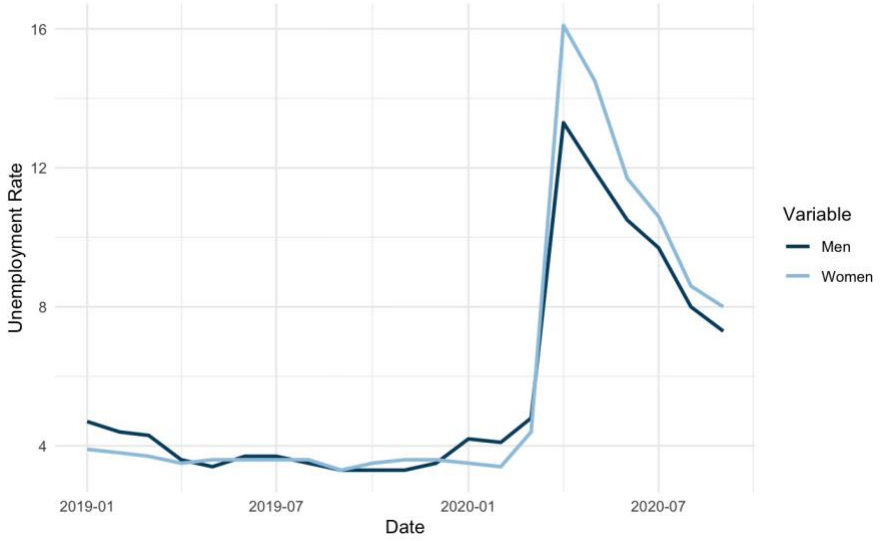
Notes: Unemployment differential is the quarterly unemployment differential of women minus men in a given region of the UK. Lockdown is a dummy variable measuring the presence of regional stay-at-home orders. Share of People Working from Home represents the share of people who did any work from home in April 2020. Data is not seasonally adjusted. Back to text
Sources: Office for National Statistics, GOV.UK.

FIGURE 2: UK ABILITY TO WORK FROM HOME BY REGION



Notes: The share of people who did any remote work in April 2020, by region. Back to text
Source: Office for National Statistics.

FIGURE 3: US UNEMPLOYMENT RATE BY GENDER



Notes: Monthly unemployment rates used; data is not seasonally adjusted. Back to text
Source: CPS Monthly Survey; data is not seasonally adjusted.

TABLE 3 – US STATE UNEMPLOYMENT LEVEL SUMMARY STATISTICS

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Men	17	4.9	3.0	3.3	3.5	4.4	13.3
Women	17	5.0	3.9	3.3	3.5	3.8	16.1
Differential (women-men)	17	0.1	1.0	-0.8	-0.6	0.2	2.8

Notes*:* Average unemployment rate in United States by gender from January 2019-May 2020. Data is available monthly; data is not seasonally adjusted. Back to text
Source: CPS Monthly Survey.

TABLE 4 – UNEMPLOYMENT BY OCCUPATION SUMMARY STATISTICS

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Men	306	4.7	5.2	0.0	2.1	5.4	43.3
Women	306	5.6	6.1	0.0	2.4	5.6	40.6
Differential (women-men)	306	0.9	3.2	-9.3	-0.8	1.7	15.9
Share of Jobs Done Remotely	306	0.3	0.3	0.0	0.0	0.5	0.9
Presence of COVID-19	306	0.2	0.4	0	0	0	1

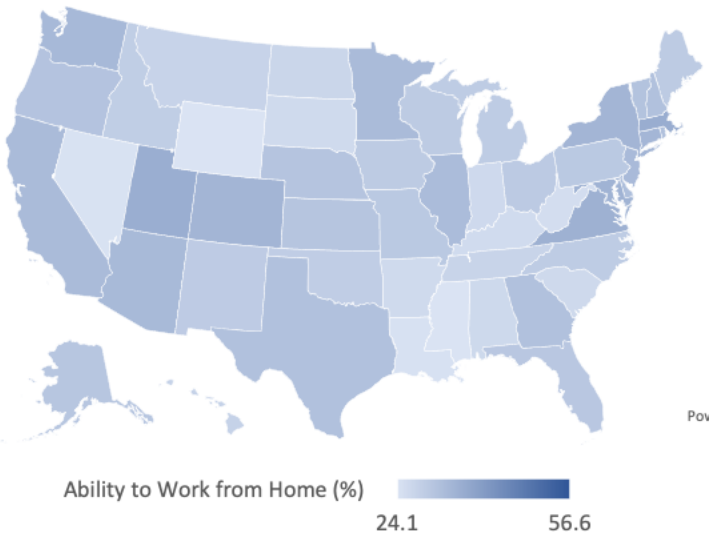
Notes: Monthly unemployment rates used. Difference is found by subtracting men's unemployment rate from women's unemployment rate in a given month. Data is not seasonally adjusted. Back to text
Source: BLS and author's calculations, Dingel and Neiman (2020) and CDC, respectively.

TABLE 5 – US STATE COVARIATE SUMMARY STATISTICS

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
State Unemployment Differential	867	-0.03	1.9	-10.4	-1.2	0.8	9.4
State Stay-at-Home Orders	867	0.1	0.3	0	0	0	1
Share of Jobs Done Remotely	867	0.3	0.05	0.2	0.3	0.3	0.6
State School Closures	867	0.2	0.4	0	0	0	3

Notes: State Unemployment Differential is the monthly unemployment rate difference of women minus men for each state. State Stay-at-Home Orders is a dummy variable that measures the presence of a mandatory stay-at-home order in a given state in a given month. State school closures is another dummy that measures if a state has closed their schools or not in a given month. Back to text
Sources: CPS Monthly Survey, CDC, Dingel and Neiman (2020), and Education Week, respectively.

FIGURE 4: US ABILITY TO WORK FROM HOME BY STATE



Notes: Share of jobs that can be done from home by state, converted to a percent. Back to text
Source: Dingel and Neiman (2020).

TABLE 6 – OCCUPATION- SPECIFIC RESULTS

	Unemployment Differential by Occupation	
	(1)	(2)
Share of Jobs that Can Be Done Remotely	2.292**	-1.255**
	(0.968)	(0.591)
Presence of COVID-19	3.618***	2.357***
	(0.863)	(0.598)
Share of Jobs that Can Be Done Remotely: Presence of COVID-19	-2.646**	-2.635*
	(1.102)	(1.407)
Constant	-1.163	0.963***
	(0.812)	(0.251)
Fixed Effects?	Yes	No
Observations	306	306
R^2	0.494	0.080
Adjusted R^2	0.430	0.071
Residual Std. Error	2.432 (df = 271)	3.106 (df = 302)
F Statistic	7.775*** (df = 34; 271)	8.801*** (df = 3; 302)

Notes: Standard errors are in parentheses under point estimates. Back to text
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

TABLE 7 – REGION SPECIFIC RESULTS FOR THE UNITED KINGDOM

	Unemployment Differential by Region	
	(1)	(2)
Stay-at-Home Order	-0.613	0.108
	(1.399)	(1.791)
Ability to Work from Home	0.914	-0.836
	(2.360)	(1.188)
Stay-at-Home Order:Ability to Work from Home	-0.773	-0.774
	(2.817)	(3.942)
Constant	-0.427	-0.043
	(1.020)	(0.540)
Fixed Effects?	Yes	No
Observations	132	132
R^2	0.575	0.015
Adjusted R^2	0.485	-0.008
Residual Std. Error	0.534 (df = 108)	0.747 (df = 128)
F Statistic	6.360*** (df = 23; 108)	0.634 (df = 3; 128)

Notes: Standard errors are in parentheses below point estimates. Back to text.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

TABLE 8 – REGION SPECIFIC RESULTS FOR THE UNITED STATES

	Unemployment Differential by State			
	(1)	(2)	(3)	(4)
Stay-At-Home Order	4.226***	3.992**		
	(1.450)	(1.775)		
School Closures			0.066	0.327
			(0.875)	(1.046)
Ability to Work from Home	70.989***	0.609	73.405***	-0.500
	(21.575)	(1.354)	(21.724)	(1.409)
Stay-At-Home-Order:Ability to Work from Home	-13.535***	-9.142		
	(4.556)	(5.649)		
School Closures:Ability to Work from Home			-2.017	2.923
			(2.779)	(3.374)
Constant	-18.470***	-0.306	-19.121***	-0.084
	(5.468)	(0.421)	(5.507)	(0.437)
Fixed Effects?	Yes	No	Yes	No
Observations	867	867	867	867
R^2	0.436	0.027	0.431	0.062
Adjusted R^2	0.388	0.024	0.383	0.058
Residual Std. Error	1.510 (df = 798)	1.906 (df = 863)	1.515 (df = 798)	1.872 (df = 863)
F Statistic	9.061*** (df = 68; 798)	8.044*** (df = 3; 863)	8.904*** (df = 68; 798)	18.915*** (df = 3; 863)

Notes: Standard errors are in parentheses below point estimates.

Back to text.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.